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ABSTRACT

This paper describes uses of technology in a rural school in Mississippi and presents the results of a study on calculator use in mathematics instruction. Computers are used in this district for scheduling, record keeping, and instruction, such as the Writing to Read Program. The National Council of Teachers of Mathematics recommends the integration of the calculator into the school mathematics program. A study was conducted with all math students in grades 1 through 12 in a rural school in Houlka, Mississippi to examine the effects of calculator use. Based on a pretest-posttest design, data were analyzed using a correlated t-test for student achievement, an independent t-test for student attitudes, and a goodness-of-fit test for parental attitudes. The students in the control group were taught mathematics in a traditional classroom setting. The experimental group received traditional classroom teaching but instruction was enhanced by the addition of calculators. For the experimental group (allowed to use calculators), there were significant differences between the means of the pretest and posttest in scores for computation and number concept. Significant differences between pre- and posttests were found in total math and math application scores for all grades tested, regardless of whether or not the students were allowed to use calculators. There was a significant difference in student attitudes from pretest to posttest, and changes in parent attitudes. Tables provide data on five participating elementary grades made up of 151 students. (KS)

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Enhancing Curriculum Through Technology in the Rural School

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Enhancing Curriculum Through Technology in the Rural School

"OHAYOO-GOZAI-MASU. WATASHI-WA ALBERT MOORE - DESU: AMERIKA-JIN DESU: KOOKED SAN-NENSEE - DESU."

With that introduction one of our seniors, Albert Moore, disrupted a U.S. Senate hearing on satellite learning programs. All the while the stenographer was frantically waving her arms. Senator Cochran told her not to worry about translating the Japanese because Albert had submitted a written copy of his testimony. By becoming one of the pilot schools in the STAR program (distance learning program), our students have had the opportunity to take courses such as Japanese and Statistics . Albert was a minority student and had never been out of the state. If not for distance learning, he would never have had this opportunity.

This is but one way technology has helped us to improve the quality of education in our rural school. Who would have thought even five years ago that a high school with less than 150 students could now offer Japanese I and II, Russian, and Probability and Statistics at all, much less economically.

The explosion of technology can be a boon or "bust" to rural or small school districts.

Hickey (1969) pointed to the principal areas of weakness of small school districts substantiated by considerable research and summarized in an ERIC document as follows:

1. Inadequacy of curriculum

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2. Inability to draw and hold high-quality teachers and administrators; inefficient use of available staff.

3. Economic inefficiencies in terms of high per pupil expenditures for the quality of program provided.

4. Inequality of effort required for support.

5. Absences of specialized services.

Twenty years later we still suffer from the same criticism. Yet, with the technology available today we are limited only by our imagination to see technology as an ally to solve perplexing problems of small schools and to combat our critics. What educational technology does require is time, resources and creativity. Adapting the tools of technology to the field of education in a rural setting is not easy. There are many barriers to overcome such as beliefs, expectations and attitudes of educators, patrons, and parents who believe in the three R's of reading, writing, and arithmetic, the lack of training in the applications and forms of assistance that technology offers, and time for an already overworked staff to become comfortable with the use of technology. These and other barriers impede progress and help foster the view that planning, curriculum, and instruction are relatively static. But with time in short supply, legislators cutting budgets, and increased record keeping requirements by state and federal agencies, how can we find time to review, revise, and expand curriculum offerings? How can we afford the costs of additional staff and equipment to expand? And what kind of results can we expect?

How can technology provide time for administrators and teachers to learn and develop necessary skills to deal with technology and carry on their daily tasks? Technology in and of itself is the answer. Today's technology literally teaches its applications. In other words, many of the programs on the market train personnel with a tutorial guide eliminating the need for formal intensive in-service training. Not only can they teach applications but they can make more efficient use of existing personnel. For example, in a matter of minutes you can generate multiple versions of a school's master schedule for a year, examining all facets of the

scheduling, such as classes, differing time blocks, and courses offered. School personnel need to experience the benefits of technology, just as the above example illustrates what an administrator can accomplish. Think of the benefits to teachers in day-to-day operations. Take, for example, the number of times students' names and grades are recorded during the school year. This enormous task is virtually eliminated with technology. The amount of time required to gain a low level of proficiency with computer technology and applications will return at least tenfold on reports that require a considerable amount of time to compile. The freedom to rearrange information to meet everyday needs is endless. And rather than give a general impression of things such as discipline to parents on a report card or at faculty meetings, you can present them with fully substantiated facts.

Fully intergrating computers with other technology will also expand the curriculum. New systems with a CD ROM player can bring alive a classroom simulation to help students understand and see concepts taught. Interactive Long Distance learning can fill the void of specialized classes at an economical cost and provide a quality program that occurs in more affluent school districts which have the student population to draw and hold high-quality specialized teachers. A CD ROM player containing a set of encyclopedias can replace 20 hard copies. As we look at all of this, we must keep in mind that the benefits will always outweigh the burden of technology.

Second, the cost of technology when examined as an additional one time outlay seems steep. But when you compare the cost of replacing traditional materials with traditional materials, the cost of the output per man hour and the results we get, it becomes less expensive than we think. For example, this last year when scheduling students we found that rather than transporting students to a vocational center twice a day, our scheduling program in fifteen minutes showed us that we could serve more students by transporting them only once a day. This saved the district in excess of $5000.00 or the cost of five microcomputers, or the already mentioned example, of replacing encyclopedias to meet requirements set in our state, the school would have to purchase at least one set of encyclopedias yearly to maintain a set of up-to-date books. This cost alone translates into enough money to purchase a CD ROM player. In other words, you need to think how technology can improve instruction

while replacing things we have traditionally bought.

In addition, you need to look for alternative sources of funding such as grants, PTO's, and business-school partnerships. It is true. If you don't write any grants, then you can 't get turned down. However, the opposite is also true. If you don't write any grants, then you can never get one. PTO's are excellent ways to raise funds in small districts, but PTO's expect to see results. For example, we asked our PTO to buy $400.00 worth of mats for a gymnastics class and the P.E. teacher built a vaulting box. At the end of the year, he had the students put on a show at a PTO meeting. The resulting effect was the next year they bought $4000.00 worth of gymnastics equipment. The same is true with technology. Unless they see results from what they buy, then they will not realize any value for the money they have raised. So whatever you do, let parents see results. If it is computer equipment, then have students carry home work done on the computer. For example, in our school we have successfully implemented the Writing To Read program for K-4 students. Using this program, all students (including SPED) are given 40 minutes of hands-on computer instruction daily. Kindergarten and first grade students use inventive spelling to create stories in their own language. To let parents see the results of this program, we use NCR paper just so we can keep copies of work and send home copies of work done by students. Businesses can also be of tremendous help, not only monetarily, but many times they will donate equipment and materials to assist in fund raisers and other types of support. As for locating grants that are available, there are several different ways, such as commercially prepared resources, mailouts that are received periodically, or if a university is near, most of them have access to a data bank which can locate grant money. Just remember, the fear of being turned down should never stop you from trying.

Last, what kind of resistance can you expect from change? What kind of results can you expect in student performance, and how do we communicate this to people who are helping us.? Too many times I have heard, "well that's not the way I learned." or "where is my child's grade?"

Results and communication of results have to be done both formally and informally. In the case of our WTR Lab, we emphasize students' work. If the students do a banner, we make sure parents realize where it came

from. There is no better proof of a program's success than being able to point out to a parent that a child is using words like "comfortable" and "reflection" in their writing in first grade, or in newspaper articles on a child taking Japanese in your school. And sometimes a more formal approach is needed. The following is a brief summary of the results we obtained when we began implementing the NCTM (National Council of Teachers of Mathematics) standards.

NCTM has proposed major reforms for the mathematics curriculum in our nation's schools. Our students, in the past and at the present, spend a majority of their mathematics classtime doing menial calculations and memorizing fact tables and very little time working on real life problems of application. In our world today, where technology is outdating itself by the time it is printed, we need our students to be able to do more than regurgitate facts. They need to know these facts, but more emphasis needs to be placed on the applications of mathematics. Without an understanding of the science of mathematics there will be no place for our students in the technological world that we are producing. The new goals not only reflect the importance of content but a need for children to learn to value mathematics and become confident in their ability to do mathematics.

The Mathematics programs in elementary schools have not changed in the past 50 years. The content as well as the methods for teaching math need to be updated. Teachers need to experience inservice programs for incorporating the use of calculators, computers, and manipulatives into their classrooms.

The traditional approach to curriculum development in mathematics is based on a rigid non-flexible structure and not on how children learn. The basic skills that students need to learn in a technological world are very different from those skills that are emphasized in today's textbooks. According to Elizabeth D. Bjork and Mark Driscoll (1988), "the most robust model for future mathematics instruction appears to be a teacher-student-technology triangle, in which students use calculators and software and teachers encourage, model, monitor, guide, and evaluate student investigation."

NCTM recommends the integration of the calculator into the school mathematics program at all grade levels in classwork, homework, and evaluation. Although extensively used in society, calculators are used far less in schools, where they could free large amounts of the time that students currently spend practicing computations. The time gained should

be spent helping students to understand mathematics, to develop reasoning, and problem solving strategies, and to use and apply mathematics.

According to Hoffman (1988), the value of effective use of models and manipulatives to affect and enhance the learning of mathematics at all levels cannot be overstated. Exploring ideas, developing understanding, and verifying results are all vital parts of the learning process. He further stated that pupils need much more than pencil and paper activities to achieve success in mathematics. The use of models and manipulatives cannot be ignored if maximum results are to be achieved.

"Studies have documented the negative effects of math anxiety on math performance and achievement." (Richardson and Swinn, 1972)

Our study group involved all the math students of our rural school in grades one through twelve. The socioeconomic status of the group was middle class to very low class. The racial background was comprised of approximately 60 percent white and 40 percent black with less then 1 percent from all other ethnic groups involved. The educational level of the study group's parents was very low; many of the parents did not graduate from high school and very few graduated from college. Most of the parents work in local furniture factories, some work on local farms and a few own their own farms or businesses.

A one group pretest-posttest was used in the study and the data analysis was completed using a correlated t-test for student achievement, an independent t-test for student attitudes, and a goodness of fit test for parental attitudes.

The students in the control group taking the pretest during the 87-88 school year were taught mathematics in a traditional classroom setting using the traditional lecture, discussion, and demonstration methods of teaching. The primary focus of the instruction was on the development of computational skills through rote memorization and drill sheets contained in workbooks.

The experimental group taking the posttest during the 88-89 school year received traditional classroom teaching but instruction was enhanced by the addition of calculators. Emphasis on basic facts was still emphasized but a greater emphasis was placed on learning to use the calculator to enhance computational skills to allow more time to work on problem solving ability and the application of mathematics to real situations and the use of manipulatives for understanding mathematics.

No workbooks full of drill sheets were used; these were replaced by the calculator and manipulatives.

The students involved in this study were given the attitudinal scale at the beginning of the school year. Then all students were taught math with the aid of manipulatives and calculators until the beginning of the fifth grading period. At this time, the students were again given the same math attitudinal scale. The results from the pretest and posttest were then evaluated using an independent t-test.

The parents were asked to complete a math survey form at the beginning of school and again at the end of the school year. These results were compared using a chi-square goodness of fit test.

As can be seen in table 1 there was a significant difference between the means of the pretest and the posttest in total mathematics achievement scores in all grades tested whether the students were allowed to use calculators or not.

TABLE 1

Comparison of Pretest and Posttest Scores for Total Mathematics

GRADE	PRETEST 88			POSTTEST 89			
	N	X	SD	N	X	SD	t-value
1**	30	471.60	49.32	30	524.13	38.13	7.60*
3**	25	591.38	31.37	25	630.27	43.03	7.71*
4	36	623.42	37.86	36	638.83	34.11	3.48*
5**	26	646.58	35.92	26	667.50	23.48	4.13*
6	34	663.65	30.94	34	670.59	37.79	3.18*

** Students allowed to use calculators

* Significant at the .05 level

As can be seen in table 2 there was a significant difference between the means of the pretest and the posttest in computation mathematics achievement scores in grades 3 and 5 where students were allowed to use calculators.

TABLE 2

Comparison of Pretest and Posttest Scores for Computation Mathematics

GRADE	PRETEST 88			POSTTEST 89			
	N	X	SD	N	X	SD	t-value
3**	25	615.15	44.71	25	670.88	48.67	6.81*
4	36	628.14	48.62	36	640.08	35.39	1.86
5**	26	676.88	46.21	26	710.10	42.18	3.53*
6	34	679.65	39.93	34	685.71	51.07	.87

** Students allowed to use calculators

* Significant at the .05 level

As can be seen in table 3 there was a significant difference between the means of the pretest and the posttest in number concepts mathematics achievement scores in grades 3 and 5 where students were allowed to use calculators.

TABLE 3

Comparison of Pretest and Posttest Scores for number concepts Mathematics

GRADE	PRETEST 88			POSTTEST 89			
	N	X	SD	N	X	SD	t-value
3**	25	598.04	29.85	25	624.81	57.82	2.68*
4	36	641.56	50.61	36	647.47	46.41	1.00
5**	26	639.54	43.57	26	656.58	22.72	2.62*
6	34	669.65	40.11	34	670.06	37.31	.09

** Students allowed to use calculators

* Significant at the .05 level

As can be seen in table 4 there was a significant difference between the means of the pretest and the posttest in application mathematics achievement scores in all grades tested whether the students were allowed to use calculators or not.

TABLE 4

Comparison of Pretest and Posttest Scores for Application Mathematics

GRADE	PRETEST 88			POSTTEST 89			
	N	X	SD	N	X	SD	t-value
3**	25	575.15	35.70	25	609.88	45.78	6.48*
4	36	612.53	48.62	36	636.94	41.07	4.47*
5**	26	622.65	39.77	26	641.19	33.58	4.01*
6	34	648.65	35.24	34	660.62	44.06	3.12*

** Students allowed to use calculators

* Significant at the .05 level

As can be seen from table 5 there was a significant difference in student attitudes from pretest to posttest at the .10 level.

TABLE 5

Comparison of Pretest and POSTTEST scores on attitudinal scale.

PRETEST			POSTTEST			t-value
N	X	SD	N	X	SD	
30**	90.33	15.53	30	98.47	15.32	1.44*

* Significant at .10 level

** N Represents number of classes

As can be seen from table 6 the frequencies of the positive responses at the end of the school year did not fit the expected per cent of positive responses from the beginning of the school year.

Table 6

Comparison of responses of parental survey Pre-to-Post.

QUESTION NO.	1	2	3	4	5	6	7	8	9	10	CHI-SQUARE
Pos. Responses	33	30	31	36	38	35	30	38	35	28	
Percent	.12	.12	.10	.13	.09	.07	.06	.09	.11	.11	22.31*

*Significant at .05 level

The purpose of this study was to look at the effects of beginning to implement the NCTM standards on student achievement, student attitudes, and parental attitudes. These standards are very innovative and this study only looked at a few of the aspects of beginning to implement these standards and difficulties involved in their implementation. For example, should students be taught to use a calculator and then not be allowed to use it on a test? To me, this is the same as asking a mechanic to fix a motor without any tools. Or will parent expectations of what should be used to teach mathematics impede the implementation of the standards? Things that were not studied during the year, but were evident from discussions with the teachers included concerns about moving away from paper and pencil activities to a more hands on approach and how to justify a grade to a parent without a paper and pencil test. Even with over 40 hours of in service on the standards and methodology, teachers' reliance on paper and pencil activities have not changed dramatically. The resistance to changes is always difficult to overcome. Our students did realize significant gains in achievement, student attitudes toward mathematics did improve, and parental attitudes changed.

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